

#2 Comparative Effects of QUERTY and DVORAK Keyboards in the NIOSH  
Health Hazard Evaluation at US West Communications

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### INTRODUCTION

In 1989, the National Institute for Occupational Safety and Health (NIOSH) received a joint request from the Communications Workers of America and US West Communications to evaluate the effects of video display terminal work on musculoskeletal problems among Directory Assistance Operators (DAOs). To address this concern, a cross-sectional study of 533 telecommunications workers (including DAOs and workers from four additional job classifications) from three different metropolitan areas in the U.S. (Minneapolis, Denver and Phoenix) was conducted.

A main goal of the study was to identify risk factors for work-related upper extremity musculoskeletal conditions. The upper extremity musculoskeletal system was assessed using a symptom questionnaire and targeted physical examinations. Data on worker demographics, individual factors (existing medical conditions and non-work activities), work practices, and the psychosocial environment were obtained from all participants by questionnaire. Additionally, ergonomic aspects of the workstation were assessed. Relationships between worker/workplace factors and musculoskeletal effects were assessed using multiple (linear and logistic) regression.

As described more fully in the NIOSH final report for this project (NIOSH, 1992), numerous individual and job variables were predictive of musculoskeletal outcome measures in the final regression models. Variables denoting intensified workload (e.g., increasing work pressure, high information processing demands, and surges in workload) were especially prominent, predicting both symptoms and signs (based on physical exam) at several body sites. Of special relevance to the Marconi '96 conference, use of the DVORAK versus QUERTY keyboard was not associated significantly with any of the musculoskeletal outcome measures. These negative findings, which were not detailed in the NIOSH (1992) report, become more apparent in a series of analyses which are summarized below and will be presented at the conference.

### METHODS

Univariate (Chi-Square and ANOVA) analyses compared musculoskeletal outcome measures between a group of 75 DAOs who used the QUERTY keyboard and 169 DAOs who used the DVORAK keyboard. These groups represented all of the DAOs sampled in the US West Communications study. (Subjects for the study were drawn at random and had a participation rate of 97%). DAOs only were selected in an effort to maximize homogeneity in job tasks. However, within this sample, QUERTY keyboards were used only at Denver and DVORAK keyboard use was exclusive to Minneapolis and Phoenix.

Comparison of QUERTY and DVORAK groups on five different musculoskeletal measures was conducted at each of five body sites (neck, shoulder, elbow, hand/wrist, back). The

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musculoskeletal outcomes are defined as follows:

1. **SYMPTOMS:** DAOs were divided into cases and non-cases based on the questionnaire reporting of symptoms (pain, aching, stiffness, burning, numbness) experienced in the last year.
2. **SYMPTOMS SCORE:** A sum score ranging from 0-17 was calculated for each DAO based upon the duration, frequency and intensity of symptoms reported in the questionnaire.
3. **WORK-RELATED SYMPTOMS:** DAOs were divided into cases and non-cases based on the questionnaire reporting of a) symptoms experienced during the prior year and beginning during tenure on the present job, and b) absence of a non-job injury to the affected site.
4. **DISORDERS 1:** DAOs were divided into cases and non-cases based on the experience of work-related symptoms (as defined above) which were reported to last more than one week, or occur at least once a month.
5. **DISORDERS 2:** DAOs were divided into cases and non-cases based upon the experience of symptoms meeting the criteria for DISORDERS 1 and a positive physical examination of the affected site.

QUERTY and DVORAK groups were compared also on select demographic and job characteristics which might be associated with stress to the musculoskeletal system. Variables examined in these analyses included the following measures.

<u>Demographic</u>	<u>Job-related</u>
Age	Recent change in workstation equipment
Gender	Hours of video display terminal (VDT) work daily
Race	Hours typing per day
Current job Tenure	Typing proficiency
	Typing technique
	Length of continuous sitting
	Number of brief breaks per day
	Number of long breaks per day
	Frequency of overtime work

## RESULTS

Analyses failed to reveal significant differences ( $p \leq .05$ ) between the QUERTY and DVORAK groups for any of the musculoskeletal outcome measures at any body site. This pattern of null effects is illustrated in Table 1, which shows a remarkable similarity of hand/wrist case prevalence rates and symptom scores between the two keyboard groups.

Job characteristics which may impose musculoskeletal demands were also quite similar between the two keyboard groups. Both groups typed and worked at their video terminals for almost

identical periods each day, took the same number of both brief and long breaks each day, and

	<u>QUERTY keyboard</u>	<u>DVORAK keyboard</u>	<u>Significance</u>
SYMPTOMS	63%	60%	ns
SYMPTOMS SCORE	6.2	5.4	ns
WORK-RELATED SYMPTOMS	44%	44%	ns
DISORDERS 1	41%	37%	ns
DISORDERS 2	13%	13%	ns

Table 1. Summary of keyboard effects on musculoskeletal outcomes for the hand/wrist.

were undifferentiated in their frequency of overtime work. Also, typing speed and "touch" typing proficiency was the same for both groups. However, a higher proportion of the DVORAK group changed their keyboard in the last year, and the length of continuous sitting was slightly, but significantly, longer for the DVORAK group.

More pronounced inequalities were seen for demographic factors. Job tenure and age were nearly identical for the two groups, but the DVORAK keyboard users were nearly twice as likely to be female and the QUERTY keyboard users were nearly twice as likely to be of a non-white race. These differences are of special concern since both female gender and non-white race had elevated odds ratios for musculoskeletal problems in final regression models in the broader study at US West Communications.

To address the possibility of a hidden influence of these variables in the present analyses, musculoskeletal differences between the QUERTY and DVORAK groups were re-examined using a reduced sample which included only white females (QUERTY  $n=25$ ; DVORAK  $n=103$ ). The pattern of results, however, was unchanged. Case prevalence rates and symptom scores were nearly equivalent to values for the fuller sample.

### CONCLUSIONS

The results suggest that musculoskeletal effects in the present sample of DAOs were not influenced by use of the QUERTY versus DVORAK keyboard. For every musculoskeletal outcomes measure, scores for the QUERTY and DVORAK groups were highly comparable in both the full sample of DAOs and in the reduced sample, the latter controlling for demographic differences between the two keyboard groups. However, several study limitations (see NIOSH, 1992) must be considered in extrapolating from these analyses. Especially apparent is the confound in the present data set between keyboard type and city location. With regard to this concern, it is notable and encouraging that variables corresponding to city location were not of major consequence in predicting musculoskeletal problems in the final regression models in the broader study as reported previously (NIOSH, 1992; Hales et al, 1994; Sauter et al., 1992).



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